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Kejun Zeng

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EXAMINER

STONER, KILEY SHAWN

ART UNIT

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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* KEJUN ZENG

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Appeal 2008-3929  
Application 10/679,787  
Technology Center 1700

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Decided: September 22, 2008

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Before BRADLEY R. GARRIS, CHARLES F. WARREN, and  
ROMULO H. DELMENDO, *Administrative Patent Judges*.

DELMENDO, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellant appeals under 35 U.S.C. § 134 from a final rejection of claims 32 and 33 (Appeal Brief filed April 16, 2007, hereinafter “Br.”; Final Office Action mailed February 13, 2006). We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

Appellant states that the invention relates to solder joints  
(Specification, “Spec.,” ¶001).

Claim 32 on appeal reads as follows:

32. A solder joint structure for a semiconductor  
apparatus having a top surface, comprising:

a two-layered copper structure at the top surface of the  
semiconductor apparatus, having a bottom layer and a top layer,  
the top layer about 0.6  $\mu\text{m}$  thick;

a nickel layer sandwiched between and contacting the  
two copper layers; and

a solder ball formed on and contacting the about 0.6  $\mu\text{m}$   
thick copper layer.

The Examiner relied upon the following prior art references in support  
of the rejections:

Erickson	6,180,265 B1	Jan. 30, 2001
Ling	6,445,069 B1	Sep. 3, 2002
Huang	6,452,270 B1	Sep. 17, 2002

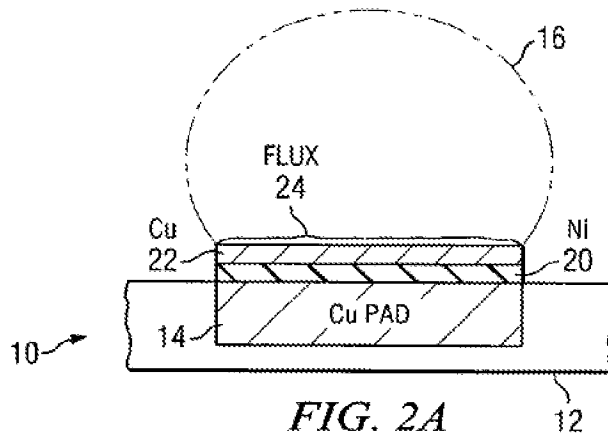
The Examiner rejected the claims under 35 U.S.C. § 103(a) as  
follows: (i) claim 32 as unpatentable over the combined teachings of  
Erickson and Ling; and (ii) claim 33 as unpatentable over the combined  
teachings of Erickson, Ling, and Huang (Examiner’s Answer mailed August  
13, 2007, hereinafter “Ans.,” 3-8).

## ISSUE

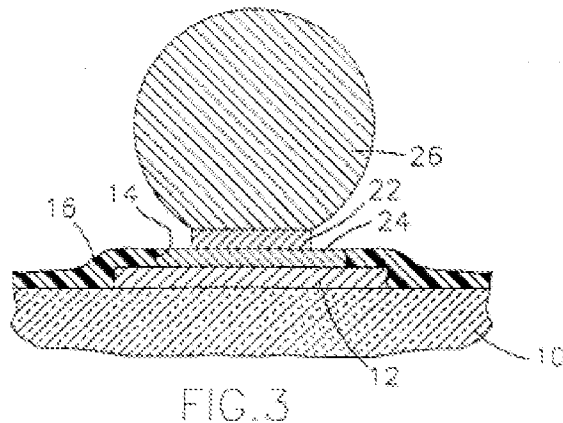
Has Appellant demonstrated error in the Examiner’s determination  
that a person a having ordinary skill in the art would have found the subject  
matter of the appealed claims obvious in view of the applied prior art?

### FINDINGS OF FACT

1. Appellant's Figure 2A is reproduced below:



2. Appellant's Figure 2A is said to depict a cut-away partial side view of a portion of a circuit board (PCB or component substrate) including a bond pad illustrating an example embodying the invention, wherein 16 is a solder ball (Spec. ¶¶016, 020).
3. Appellant's Specification states: "A copper layer 22 thickness in excess of about 6 microns, however, provides abundant copper to diffuse through the intermetallic compounds formed at the interface of the solder joint, forming a great amount of Kirkendall voids and thus resulting in a weak bond" (¶023).
4. Erickson describes a flip chip solder bump pad (Figure 3).
5. Erickson's Figure 3 is reproduced below:



6. Erickson's Figure 3 is said to depict a flip chip solder bump pad, wherein 10 is an IC device, 12 aluminum wire bond pad, 14 is a square-shaped opening, 16 is a passivation layer of a dielectric material, 24 is a nickel layer, 22 is a copper bond pad, and 26 is a solder bump (col. 3, l. 27 to col. 4, l. 28).
7. Ling teaches (col. 1, ll. 6-12):

Manufacturers of semiconductor integrated circuits have been experimenting with the use of copper to form the interconnect metallization upon integrated circuits. *Copper has much better conductivity than the traditional aluminum metallization that has been used in past years, and improved conductivity is essential to achieve higher speed operation.* [Emphasis added.]
8. Ling further teaches that "solder bumps are often formed on integrated circuit wafers of the type that are used in providing so-called flip chip integrated circuit packages and/or chip scale packages" (col. 1, ll. 20-23).
9. In describing Figure 1 (col. 3, l. 48 to col. 4, l. 46), Ling teaches that "metal interconnect layers have been formed of aluminum,

though copper is now being used to enhance the conductivity, reliability and speed of circuitry, especially for very fine line geometries used in advanced generations of integrated circuit technologies” (col. 4, ll. 16-20).

10. Ling teaches that it is known that a nickel layer serves as a barrier layer between copper and gold (col. 1, ll. 36-38).

#### PRINCIPLES OF LAW

On appeal to this Board, Appellant must show that the Examiner erred in finally rejecting the claims. *Cf. In re Kahn*, 441 F.3d 977, 985-986 (Fed. Cir. 2006) (“On appeal to the Board, an applicant can overcome a rejection by showing insufficient evidence of *prima facie* obviousness or by rebutting the *prima facie* case with evidence of secondary indicia of nonobviousness.”) (quoting *In re Rouffet*, 149 F.3d 1350, 1355 (Fed. Cir. 1998)); *see also* 37 C.F.R. § 41.37(c)(1)(vii).

“Section 103 forbids issuance of a patent when ‘the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.’” *KSR Int’l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1734 (2007).

*KSR* reaffirms the analytical framework set out in *Graham v. John Deere Co.*, 383 U.S. 1 (1966), which states that an objective obviousness analysis includes: (1) determining the scope and content of the prior art; (2) ascertaining the differences between the prior art and the claims at issue; and (3) resolving the level of ordinary skill in the pertinent art. *KSR*, 127 S. Ct.

at 1734. Secondary considerations such as commercial success, long felt but unsolved needs, or failure of others “‘might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.’” *Id.* (quoting *Graham*, 383 U.S. at 17-18).

*KSR* disapproved a rigid approach to obviousness (*i.e.*, an analysis *limited to* lack of teaching, suggestion, or motivation). *KSR*, 127 S. Ct. at 1741 (“The obviousness analysis cannot be confined by a formalistic conception of the words teaching, suggestion, and motivation, or by overemphasis on the importance of published articles and the explicit content of issued patents.”). *See also DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1367 (Fed. Cir. 2006) (“Our suggestion test is in actuality quite flexible and not only permits, but *requires*, consideration of common knowledge and common sense”); *Alza Corp. v. Mylan Labs., Inc.*, 464 F.3d 1286, 1291 (Fed. Cir. 2006) (“There is flexibility in our obviousness jurisprudence because a motivation may be found *implicitly* in the prior art. We do not have a rigid test that requires an actual teaching to combine...”).

*KSR* further instructs “that when a patent claims a structure already known in the prior art that is altered by mere substitution of one element for another known in the field, the combination must do more than yield a predictable result.” *KSR*, 127 S. Ct. at 1740.

Any need or problem known in the field of endeavor at the time of the invention and addressed by the prior art can provide a reason for combining the elements in the manner claimed. *KSR*, 127 S. Ct. at 1742. *See also In re Kemps*, 97 F.3d 1427, 1430 (Fed. Cir. 1996); *In re Dillon*, 919 F.2d 688, 693

(Fed. Cir. 1990)(*en banc*) (the motivation to combine the prior art references need not be identical to that of Applicants).

Also, mere attorney arguments or conclusory statements do not take the place of evidence. *See, e.g., In re Geisler*, 116 F.3d 1465, 1470 (Fed. Cir. 1997).

## ANALYSIS

Appellant has argued the two rejections together, focusing on claim 32. Accordingly, we confine our discussion to claim 32. *See* 37 C.F.R. § 41.37(c)(1)(vii).

The Examiner found that Erickson describes a flip chip solder bump pad structure including every element recited in appealed claim 32 except that: (1) the prior art structure has an aluminum wire bond pad instead of the here claimed copper pad; and (2) the prior art copper layer 22 thickness is not disclosed (Facts 1, 2, and 4-6; Ans. 3-4). To account for the first difference, the Examiner relied on the teachings of Ling, which states that “[c]opper has much better conductivity than the traditional aluminum metallization that has been used in past years, and improved conductivity is essential to achieve higher speed operation” (Facts 7-9). Based on the collective teachings of the prior art references, the Examiner concluded that “[i]t would have been obvious to one of ordinary skill in the art at the time of the invention to modify the pad material to utilize copper in order to provide better thermal conductivity...” (Ans. 4). With respect to the thickness of the copper layer 22, the Examiner held that it would have been obvious for one of ordinary skill in the art to arrive at the claimed thickness through routine optimization (Ans. 4).



Appellant advances three arguments against the Examiner's position that a person having ordinary skill in the art would have found it obvious to arrive at the here claimed subject matter. First, Appellant contends that "[h]ad a person skilled in the art replaced the aluminum pad [of Erickson] with a copper pad, as suggested in the Office Action, then the solderability would have been realized, without the additional nickel layer and the top layer" (Br. 3). Second, Appellant argues that "copper bond pads are difficult for wire-bonding because the oxide layer formed on copper does not break up during wire-bonding and reliable wire-bonds are difficult to make" (Br. 4). Third, Appellant urges that the prior art references do not recognize the same problem solved by the present invention (Br. 4-5). Specifically, Appellant asserts that "[t]he nickel layer is to reduce the out-diffusion of the copper atoms from the top surface of the bottom copper pad where the formation of excessive Kirkendall voids tends to degrade the reliability of the [semiconductor] devices" (Br. 4).

None of Appellant's arguments are persuasive to show error. Ling provides strong evidence that copper wire bond pads have been used advantageously, and interchangeably with aluminum pads, to form solder joint structures when combined with other layers including a nickel layer. Here, Ling teaches that copper wire bond pads exhibit superior conductivity, reliability, and speed of circuitry (Facts 7-9). Thus, we share the Examiner's view that a person having ordinary skill in the art would have found it obvious to replace the aluminum wire bond pad with a copper wire bond pad in order to obtain the known advantages of copper wire bond pads. "[W]hen a patent claims a structure already known in the prior art that is altered by mere substitution of one element for another known in the field, the

combination must do more than yield a predictable result.” *KSR*, 127 S. Ct. at 1740.

We are also unpersuaded by Appellant’s allegation that “copper bond pads are difficult for wire-bonding” (Br. 4). This allegation is unsubstantiated by evidence and is therefore ineffective to rebut the Examiner’s *prima facie* case of obviousness. In this regard, mere attorney arguments or conclusory statements do not take the place of evidence. *See, e.g., In re Geisler*, 116 F.3d at 1470.

Lastly, Appellant’s argument that the prior art does not recognize the same problem (reduction of Kirkendall voids) is likewise unpersuasive. Appellant’s Specification states: “A copper layer 22 thickness in excess of about 6 microns, however, provides abundant copper to diffuse through the intermetallic compounds formed at the interface of the solder joint, forming a great amount of Kirkendall voids and this resulting in a weak bond” (Fact 3). Appellant has not shown that the problems addressed by the prior art are in fact different from that of the present invention.<sup>1</sup> Indeed, *Ling* teaches that the nickel layer, like Appellant’s nickel layer, serves as a barrier layer between copper and gold (Fact 10). Moreover, any need or problem known in the field of endeavor at the time of the invention and addressed by the prior art can provide a reason for combining the elements in the manner claimed. *KSR*, 127 S. Ct. at 1742. *See also In re Kemps*, 97 F.3d at 1430; *In re Dillon*, 919 F.2d at 693 (the motivation to combine the prior art references need not be identical to that of applicant).

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<sup>1</sup> To the extent that Appellant relies on the claimed top copper layer thickness, we have not been directed to any evidence demonstrating any unexpected criticality for the claimed thickness.

For these reasons, we uphold the Examiner's obviousness rejections.

### CONCLUSION

On this record, we determine that Appellant has failed to demonstrate any error in the Examiner's determination that claim 32 is unpatentable over the combined teachings of Erickson and Ling and claim 33 is unpatentable over the combined teachings of Erickson, Ling, and Huang.

### DECISION

The Examiner's decision to reject appealed claims 32 and 33 is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

PL Initial:  
sld

Appeal 2008-3929  
Application 10/679,787

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